



(11) AU-A1-45,786/79

LAPSED S.47D(1)

(12) PATENT SPECIFICATION  
ABSTRACT  
(19) AU

(21) 45,786/79 (22) 6.4.79 (24) 6.4.79  
(43) 9.10.80  
(51)<sup>2</sup> F04B 43/08 F04B 47/04 E02D 1/06  
(54) Multistage water sampler  
(71) Riha, M., and Water Research Foundation  
of Australia Ltd.  
(72) Riha, M.  
(57) Claim

Claim 1. A multistage sampler comprising an outer rigid tube accommodating an inner elongate flexible tubular membrane, having a top non-returnable valve attached to the flexible tubular membrane at the valve inlet side and at the valve outlet side joined to an threaded or plain outlet pipe. Having a bottom non-returnable valve joining an inlet pipe at the valve inlet side and attached to the flexible tubular membrane at the valve outlet side. The space between the outer rigid tube and the flexible tubular membrane is pressurized by air or liquid or air-liquid periodically and depressurized. The sampled liquid being inside the flexible tubular membrane, entering through the inlet pipe and bottom non-returnable valve, is squeezed through the top non-returnable valve into the outlet pipe. A repeated pressurizing and depressurizing the flexible tubular membrane is causing the sampled liquid to rise through the outlet pipe to the level, where the liquid could be collected.



Form 10

PATENTS ACT 1952-1973

**COMPLETE SPECIFICATION**

(ORIGINAL)

FOR OFFICE USE

Class:

Int. Cl:

Application Number:  
Lodged:Complete Specification—Lodged:  
Accepted:  
Published:

Priority:

Related Art:

## TO BE COMPLETED BY APPLICANT

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-6 APR 1979

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Complete Specification for the invention entitled: multistage water sampler

The following statement is a full description of this invention, including the best method of performing it known to me:—

\*Note: The description is to be typed in double spacing, pica type face, in an area not exceeding 250 mm in depth and 160 mm in width, on tough white paper of good quality and it is to be inserted inside this form.

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The invention consists of a rigid tube, top and bottom non-returnable valves, a flexible tube membrane, a liner or liners for compressed air or pressurized liquid or air-liquid combination, a water outlet pipe, a water inlet pipe, a perforated, slotted or screened water inlet pipe with a filter with top and bottom rubber packers.

This invention relates to sampling liquids from bores, surface waters such as dams reservoirs, sea and so on and is suitable for special pumping tests in rocks with low permeability.

10 This invention enables taking liquid samples from very narrow bores from 30 mm to any larger diameter and also from different strata or layers separately.

Figure 1 and 2 is a view of a section and plan of the multi-stage sampler. Sampled water is squeezed upwards by applying air (liquid or air-liquid) pressure between the tube D and the flexible membrane  $F_1$ . The membrane  $F_1$  is attached to the rigid fitting  $E_1$  by  $F_2$  joint withstanding a pressure of at least 10 atm. The pressurized water being inside the membrane  $F_1$  opens the upper non-returnable valve  $A_1$  and at the same time closes the lower non-returnable valve  $A_2$ . After the air (liquid or air-liquid) pressure is released, the upper valve  $A_1$  closes by gravity. The bottom valve  $A_2$  opens because of the pressure head differences and the sampled water fills the space inside the flexible tube membrane. The governed and repeated pressurizing and depressurizing of the membrane  $F_1$  is controlled by a pneumatically operated automatic timer(s) and thus, the sampled water is pumped through the pipe C towards the surface from any depth and strata and eventually collected. The sampled water is not subject to any contamination, or chemical changes, or biochemical changes, being in direct contact only with the membrane, fittings and pipes. The sampled water is entering the bottom valve  $A_2$  through the inlet pipe I. This pipe is or perforated, slotted or screened. If the sampled water contains silt or other fine material, which could damage the multiple sampler, a filter is provided n, surrounding the inlet pipe I. Top rubber packer  $G_1$  and bottom

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rubber packer  $G_2$  enable sample of water to be taken from any depth required. The top rubber packer  $G_1$  is or attached to the bottom of the multistage sampler, or the pipe  $I$  is extended to the planned depth, where the top rubber packer  $G_1$  is positioned and followed in the downward direction by the perforated, slotted or screened section of the inlet pipe  $I$ , the bottom rubber packer  $G_2$  and the plug  $J$ .

Figure 3 and 4 is a view of a section and plan of the multistage sampler with bottom pipe connections enabling joining another identical multistage sampler which is located beneath the drawn one. The pipe  $C$  is common for both of the multistage samplers. Each of these samplers is equipped with separate liners  $B$  and  $K$  for the compressed air (liquid or air-liquid) supply. If, for example the flexible tube membrane of the bottom multistage sampler is activated by the liner  $K$ , the squeezed water is rising through the pipe  $L$ , the upward sampler and the outlet pipe  $C$ . Firstly the stagnant water is pumped out. After a known time of pumping, the water from the required depth is collected.

Figure 5 is a view of a section and plan of the multistage sampler, where the liner providing the supply of compressed air (liquid, air-liquid) is common for any number of multistage samplers positioned below. Each of the multistage samplers is equipped with a separate outlet water pipe. Figure 5 shows two multistage samplers with the outlet pipe  $C$  for the top sampler and the  $M$  outlet water pipe for the bottom sampler. When compressed air (liquid or air-liquid) is applied, the sampled liquid is rising through the individual water pipes simultaneously from different levels sampled.

The limitation of the use of compressed air is the depth of the strata which should be sampled. If the depth is too deep, there is not enough pressure transmitted through the liner to operate the flexible tube membrane. In this case, the entire liner is filled with liquid, which operates the membranes, or the liner

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70 is firstly filled with the sampled liquid to the natural static water level and than the compressed air pressurizes the liquid as a medium, squeezing consequently the flexible tube membranes of the multistage samplers.

If bore diameter allows or if surface water is sampled,  
75 a number of inlet pipes equipped with valves are attached to the multistage sampler. Water from a particular depth is then sampled by operating the valve of the inlet pipe ones upon a time.

The claims defining the invention are as follows:

Claim 1. A multistage sampler comprising an outer rigid tube accommodating an inner elongate flexible tubular membrane, having a top non-returnable valve attached to the flexible tubular membrane at the valve inlet side and at the valve outlet side joined to an threaded or plain outlet pipe. Having a bottom non-returnable valve joining an inlet pipe at the valve inlet side and attached to the flexible tubular membrane at the valve outlet side. The space between the outer rigid tube and the flexible tubular membrane is pressurized by air or liquid or air-liquid periodically and depressurized. The sampled liquid being inside the flexible tubular membrane, entering through the inlet pipe and bottom non-returnable valve, is squeezed through the top non-returnable valve into the outlet pipe. A repeated pressurizing and depressurizing the flexible tubular membrane is causing the sampled liquid to rise through the outlet pipe to the level, where the liquid could be collected.

Claim 2. A multistage sampler as stated under the Claim 1 with the inlet pipe perforated, slotted, screened or with a filter surrounding the inlet pipe, having top and bottom rubber packers enabling the liquid sample to be taken from a particular depth.

Claim 3. A multistage sampler as stated under the Claim 1+2, having the top and bottom non-returnable valves attached to the rigid tube from the outside.

Claim 4. A multistage sampler as stated under the Claim 1+2, having the top and bottom non-returnable valves attached to the rigid tube from the inside, joining directly the flexible tubular membrane.

Claim 5. A multistage sampler as stated under the Claim 1+2+3, having the inlet and outlet pipe positioned centrally at the top end and bottom end of the rigid tube.

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Claim 6. A multistage sampler as stated under the Claim 1+2+4 having the inlet and outlet pipe positioned outside the centre of the top end and bottom end of the rigid tube.

Claim 7. A multistage sampler as stated under the Claim 1+2+4+6 having the inlet pipe common for a number of samplers and having the liner for the pressurized air or liquid or air-liquid attached individually to each of the samplers.

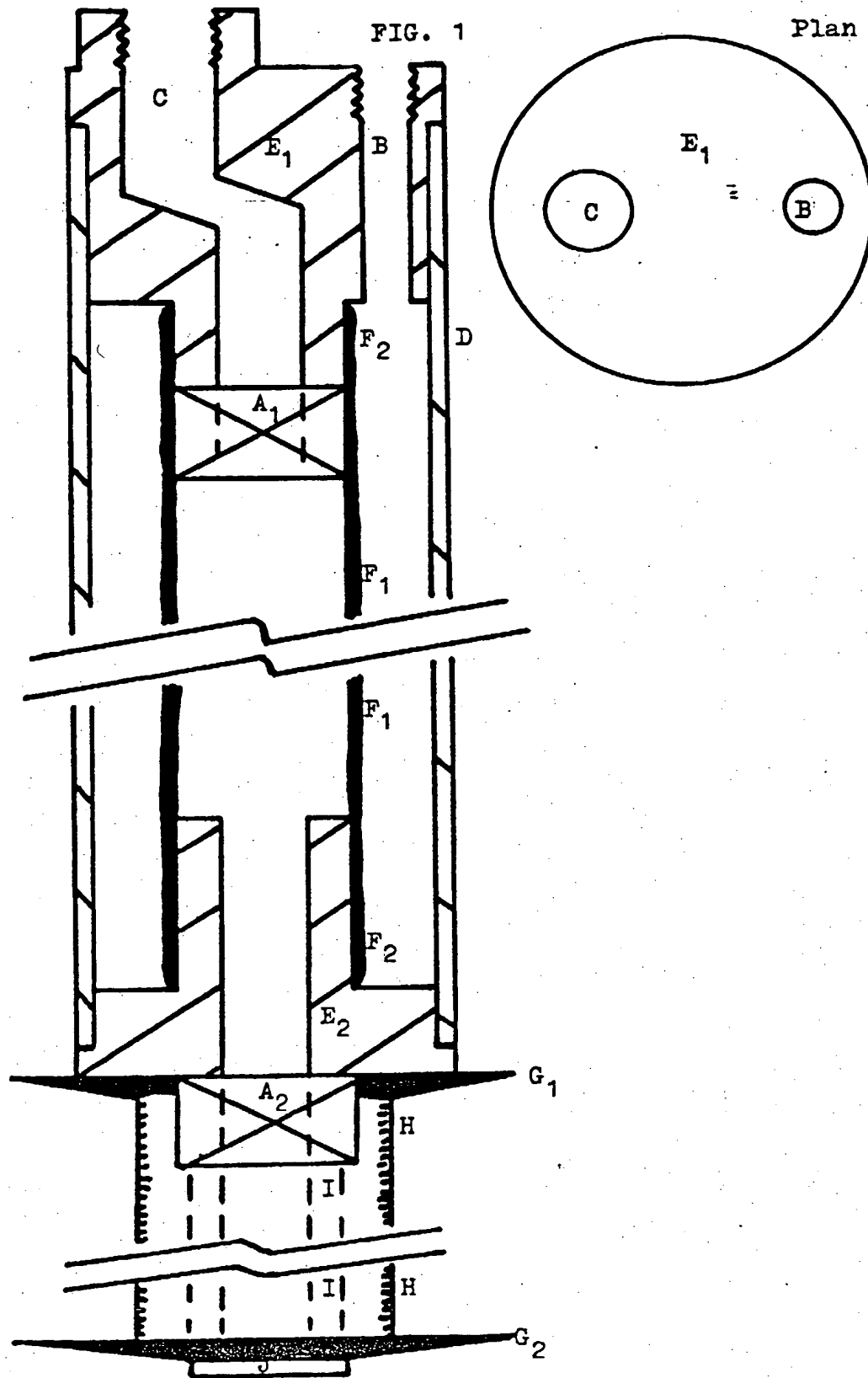
Claim 8. A multistage sampler as stated under the Claim 1+2+4+6 having the liner for pressurized air or liquid or air-liquid common for the number of samplers in operation and having the outlet pipe attached individually to each of the multistage samplers.

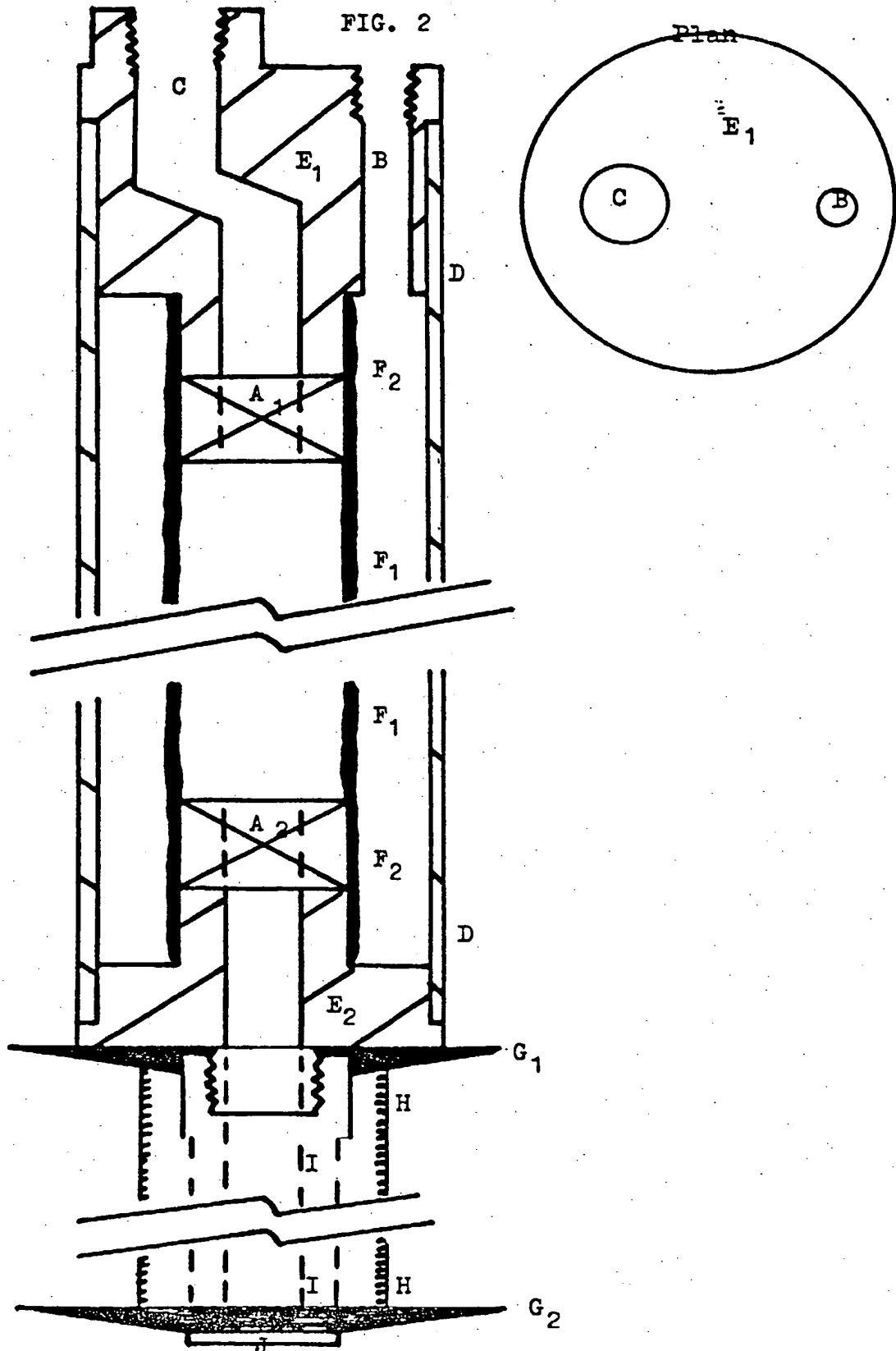
Claim 9. A multistage sampler as stated under the Claim 1+2+3+4+5+6, having a number of inlet pipes equipped with individual valves and attached to the inlet of the non-returnable valve, enabling sampling from different strata with one multistage sampler only.

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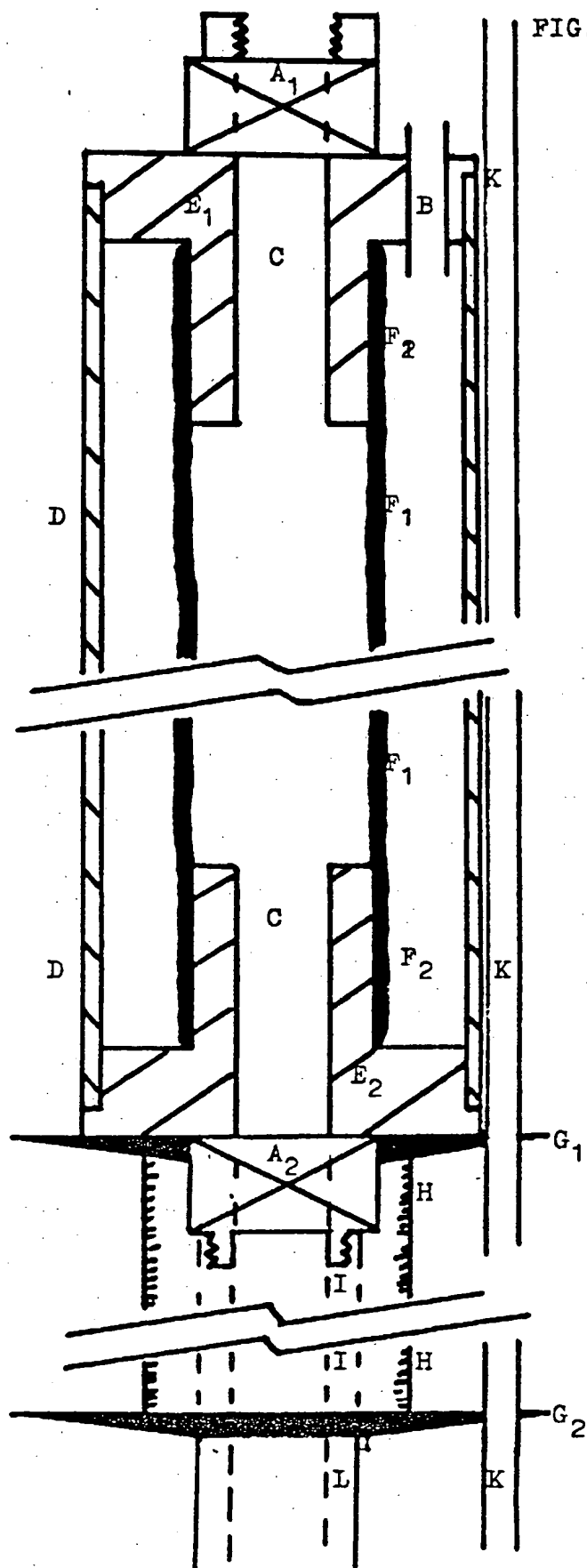
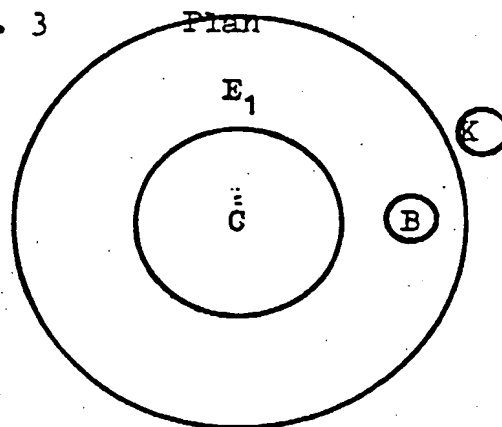
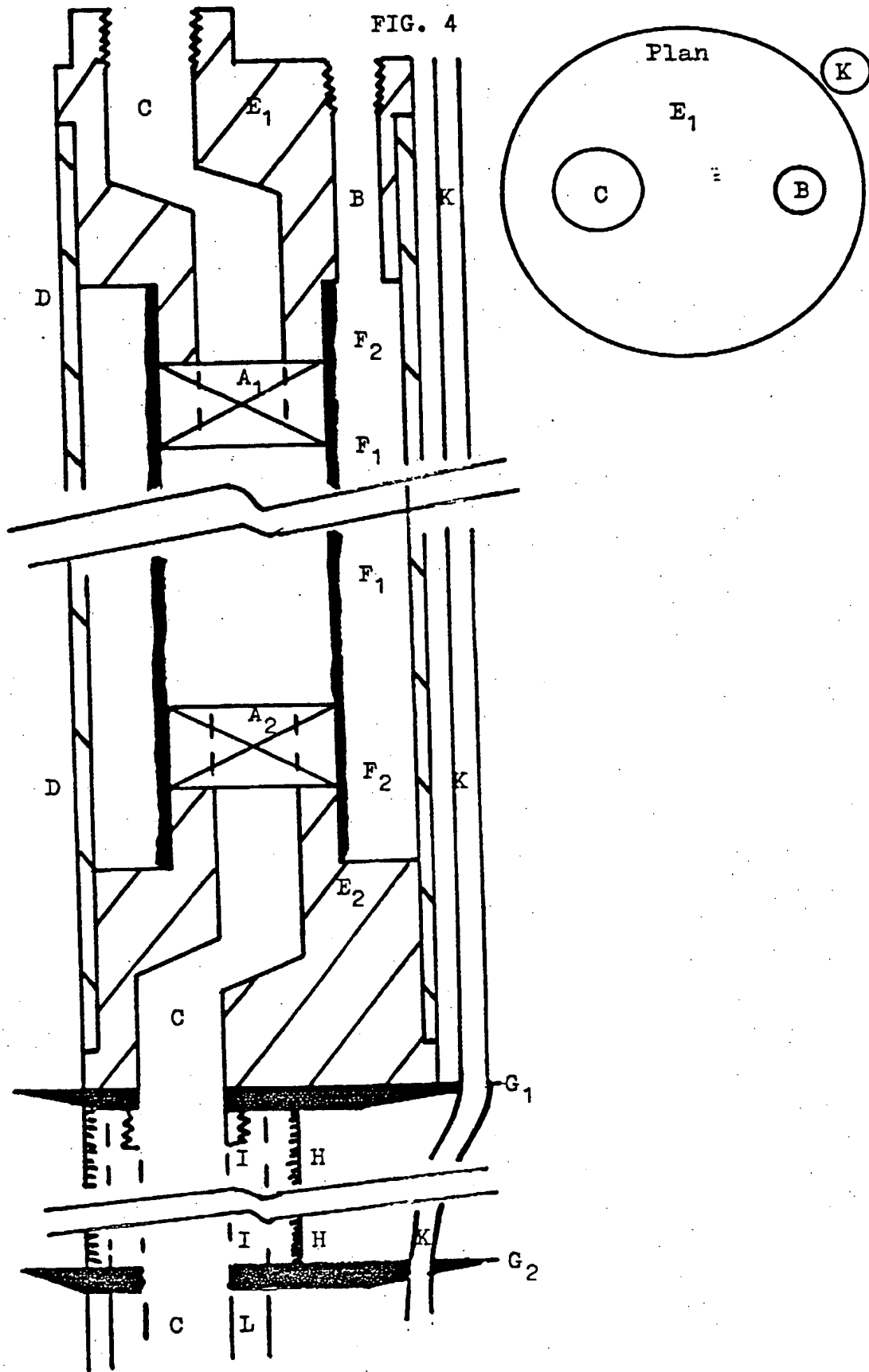
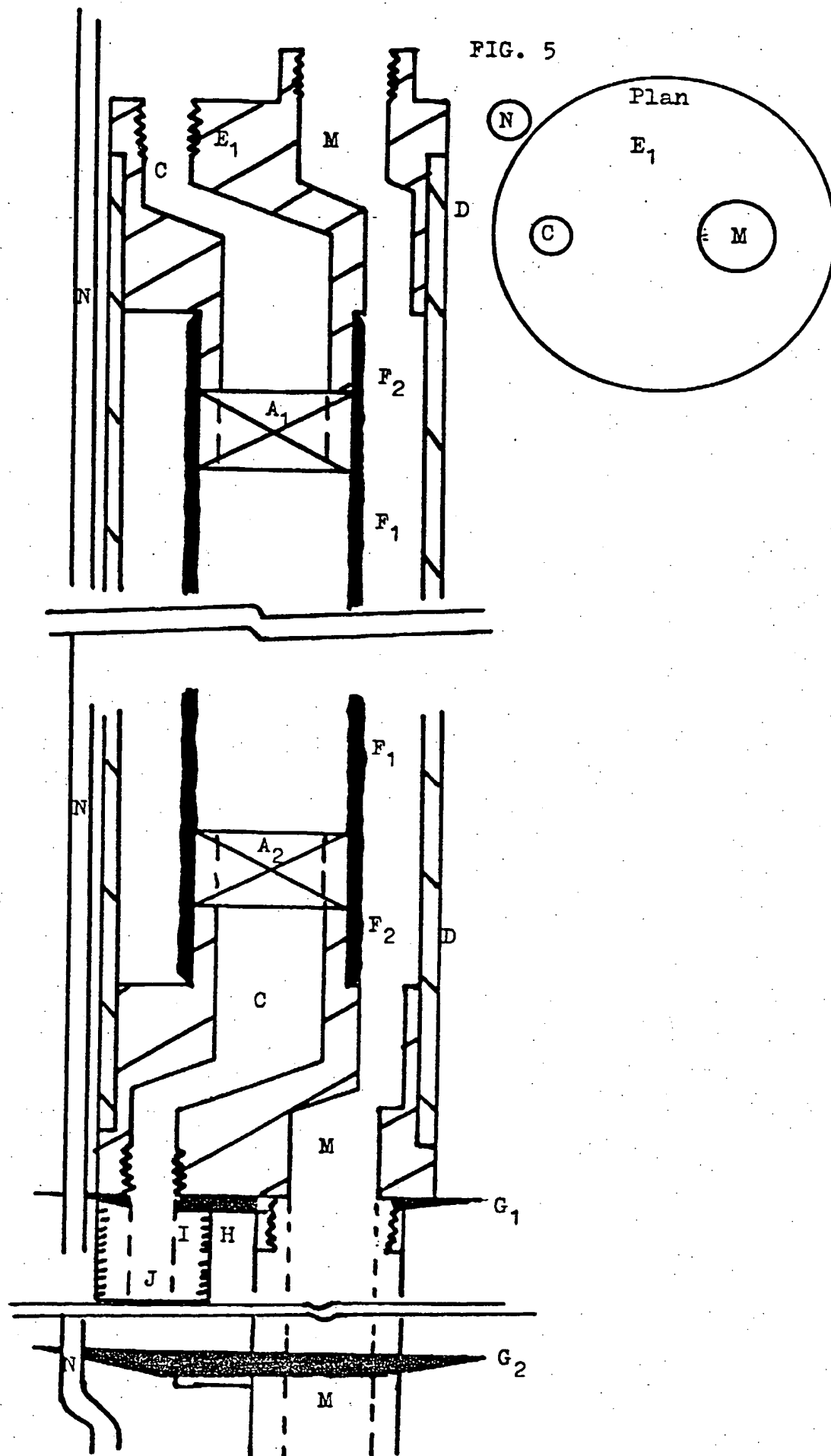


FIG. 3







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